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ABSTRACT

This brief paper considers ways in which people with learning disabilities can benefit from both mainstream and specialized computer hardware and software. First, definitions are provided of terminology, including terms such as dysgraphia, dyscalculia, dyspraxia, non-verbal learning disorder, and dyslexia. Discussion of the role of assistive technology in accommodating learning disabilities precedes explanations of specific computing tools. These include word processors, reading systems, concept mapping software, phonetic spelling programs, word prediction programs, speech recognition programs, organizational software, personal information managers, and talking calculators. The value of low tech tools (such as post-it notes and highlighter pens) is also noted. The paper also lists contact and other information resources associated with Project DO-IT at the University of Washington. (DB)

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Working Together: Computers and People with Learning Disabilities

University of Washington
DO-IT

2000

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Working Together: Computers and People with Learning Disabilities

A specific learning disability (LD) is in most situations a "hidden disability." Because there are no outward signs of a disability such as a white cane or wheelchair, people with an LD are often neglected when considering adaptive computer technology. However, many people with learning disabilities can benefit from mainstream and specialized hardware and software to operate a computer and further their academic and career goals.

Definitions and Terminology

A specific learning disability is unique to the individual and can appear in a variety of ways. It may be difficult to diagnose, to determine impact, and to accommodate.

Generally speaking, someone may be diagnosed with a learning disability if he/she is of average or above-average intelligence and there is a lack of achievement at age and ability level, or a large discrepancy between achievement and intellectual ability.

An untrained observer may conclude that a person with a learning disability is "lazy" or "just not trying hard enough." He may have a difficult time understanding the large discrepancy between reading comprehension and proficiency in verbal ability. The observer sees only the input and output, not the processing of the information. Deficiencies in the processing of information make learning and expressing ideas difficult or impossible tasks. Learning disabilities usually fall within four broad categories:

- **Spoken language** - listening and speaking.
- **Written language** - reading, writing and spelling.
- **Arithmetic** - calculation and concepts.
- **Reasoning** - organization and integration of ideas and thoughts.

A person with a learning disability may have discrepancies in one or all of these categories. The effects of an LD are manifested differently for different individuals and range from mild to severe. Learning disabilities may also be present along with other disabilities such as mobility or sensory impairments. Often people with Attention Deficit Disorder/Attention Deficit Hyperactive Disorder (ADD/ADHD) also have learning disabilities. Specific types of learning disabilities include:

- **Dysgraphia** - An individual with Dysgraphia has a difficult time with the physical task of forming letters and words using a pen and paper and has difficulty producing legible handwriting.
- **Dyscalculia** - A person with Dyscalculia has difficulty understanding and using math concepts and symbols.
- **Dyspraxia** - Language comprehension of a person with Dyspraxia does not match language production. She may mix up words and sentences while talking.
- **Non-verbal Learning Disorder** - A non-verbal Learning Disorder is demonstrated by below-average motor coordination, visual-spatial organization, and social skills.
- **Dyslexia** - An individual with Dyslexia may mix up letters within words and words within sentences while reading. He may also have difficulty spelling words correctly while writing; letter reversals are common. Some individuals with Dyslexia may also have a difficult time with navigating and route finding using right/left and/or compass directions.

Accommodations

Assistive and adaptive technology does not "cure" a specific learning disability. These tools compensate rather than remedy, allowing a person with an LD can demonstrate his intelli-

gence and knowledge. Adaptive technology for the person with an LD is a made-to-fit implementation. Trial and error may be required to find a set of appropriate tools and techniques for a specific individual. Ideally, a person with an LD plays a key role in selecting her technology. She should help to determine what works and what does not. Once basic tools and strategies are selected, they can be "test driven," discarded, adapted, and/or refined.

Following are descriptions of some computing tools that have been used effectively by individuals with specific learning disabilities. This list is not exhaustive and should not limit the person with an LD or the adaptive technology practitioner from trying something new. Today's experimental tinkering could lead to tomorrow's commonly used tool.

- **Word Processors**

Computer-based accommodations for Dyslexia may not require specialized hardware or software. For example, a person with Dyslexia can benefit from regularly using built-in word processor features such as:

- Spell checking.
- Grammar checking.
- Font size and color changes.

These built-in features are relatively low priced tools that, when used together, provide an alternative to handwritten expression. The use of spell checkers can allow the person with learning difficulties to remain focused on the task of communication rather than getting bogged down in the process of trying unsuccessfully to identify and correct spelling errors. Many word processing programs also include tools for outlining thoughts and providing alternative visual formats that may compensate for difficulty in organizing words and ideas. Additionally, color-coded text options and outline capabilities present in many word processing programs are useful tools for those with difficulty sorting and sequencing thoughts and ideas. Additionally, color-coded text options and outline capabilities present in many word processing programs are useful tools for those with difficulty sorting and sequencing thoughts and ideas.

A word processor can also be used as a compensatory tool for a person with Dysgraphia. Use of a keyboard may be a viable alternative for an individual who has difficulty expressing his thoughts via handwriting.

- **Reading Systems**

An individual who can take in information through listening much better than by reading may benefit from using a reading system. These systems allow text on screen (document, Web page or e-mail) to be read aloud through the computer's sound card. A scanner and Optical Character Recognition (OCR) software (e.g., Freedom Scientific's WYNN or L&H's Kurzweil 3000) adds the feature of reading printed text. Hard copy text is placed on the scanner where it is converted into a digital image. This image is then converted to a text file, making the characters recognizable by the computer. The computer can then read the words back using a speech synthesizer and simultaneously present the words on screen.

Reading systems include options such as highlighting a word, sentence, or paragraph using contrasting colors. If desired, the reader may elect to have only one word at a time appear on the screen to improve her grasp of the material. Increasing the size of the text displayed on the screen as well as changing text color can increase reading comprehension for some people with specific learning disabilities.

- **Concept Mapping**

Some individuals have difficulty organizing and integrating thoughts and ideas while writing. Concept mapping software allows for visual representation of ideas and concepts. These representations are presented in a physical manner and can be connected with arrows to show the relationship between ideas. These graphically represented ideas can be linked, rearranged, color coded, and matched with a variety of icons to suit the need of the user. Concept mapping software can be used as a

structure for starting and organizing such diverse writing projects as poetry, term papers, resumes, schedules, or even computer programs.

- **Phonetic Spelling**

People with Dyslexia often spell phonetically, making use of word prediction or spell checking software less useful. Devices (e.g., Franklin Electronic Dictionary ™) or software (YakYak ™) that renders phonetic spelling into correctly spelled words may be useful tools.

- **Word Prediction**

Spelling words correctly while typing can be a challenge for some people with Dyslexia. Word prediction programs prompt the user with a list of most likely word choices based upon what has been typed so far. Rather than experiencing the frustration of remembering the spelling of a word, he can refer to the predictive list, choose the desired word and continue with the expression of thoughts and ideas.

- **Speech Recognition**

Speech recognition products provide appropriate tools for individuals with a wide range of learning disabilities. Speech recognition software takes the spoken word via a microphone and converts it to machine-readable format. The user speaks into a microphone either with pauses between words (discrete speech) or in a normal talking manner (continuous speech). The discrete product, although slower, is often the better choice for those with LDs because identifying errors can be done as they occur. Making corrections after the fact using continuous speech requires good reading skills. Speech recognition technology requires that the user have moderately good reading comprehension to correct the program's text output. Because many people with LDs have reading problems, speech recognition is not always an appropriate accommodation.

- **Organizational Software/Personal Information Managers (PIMs)**

Organizing schedules and information is difficult for some people with Dyslexia and/or Non-verbal Learning Disorder. Personal Information Managers (PIMs) such as a Palm Pilot™ or Casio™ or organizational software such as Microsoft Outlook™ or Lotus Organizer™ can accommodate these disabilities. Such tools can be helpful to those with LDs by providing a centralized and portable means of organizing schedules and information. The cues provided by these tools can assist keeping on task and may help provide visual alternatives to represent what work needs to be done and what has been accomplished. However, they may also put early learners at a disadvantage by requiring yet another program and interface to learn and remember to use. Individuals may lack the discipline/attention skills to regularly check the application/device.

- **Talking Calculators**

A talking calculator is an appropriate tool for people with Dyscalculia. The synthesized voice output of a talking calculator provides feedback to the user that helps them identify any input errors. Additionally, hearing the calculated answer can provide a check against the transposition of numbers commonly reversed in reading by people with Dyslexia or Dyscalculia.

- **Low Tech Tools (Post-It Notes, Highlighters)**

Not all assistive technology for people with LDs is computer-based. The use of common office supplies such as Post-It Notes™ and highlighter pens provide elegantly simple means of sorting and prioritizing thoughts, ideas, and concepts. Often, tools of one's own making provide the most effective and comfortable accommodations for learning difficulties.

Videotape

A twelve-minute videotape, *Working Together: Computers and People with Learning Disabilities*, demonstrates key points summarized in this handout. It may be purchased by sending $25 to DO-IT. Contact DO-IT for a list of more than 20 other videotapes that may be of interest. Permission is granted to reproduce DO-IT videotapes for educational, non-commercial purposes as long as the source is acknowledged.

Resources

For more information about Learning Disabilities and possible accommodations, consider the following Web sites.

- LD OnLine: *http://www.ldonline.org/*
- LD Resources: *http://www.ldresources.com/*
- International Dyslexia Association: *http://interdys.org/*
- National Center for Learning Disabilities: *http://www.ncld.org/*

Useful information about products that can assist an individual with an LD can be found at the following Web sites.

- Casio Personal Assistant: *http://www.casio.com/*
- Franklin Electronic Dictionary: *http://www.franklin.com/*
- Freedom Scientific WYNN: *http://www.freedomscientific.com/wynn/*
- Inspiration Software: *http://www.inspiration.com/*
- L&H Kurzweil 3000: *http://www.lhsl.com/education/*
- Lotus Organizer: *http://www.lotus.com/home.nsf/welcome/organizer/*
- Microsoft Outlook: *http://www.microsoft.com/outlook/*
- Palm Pilot: *http://www.palm.com/*
- Yak-Yak Software (for phonetic spelling): *http://www.yak-yak.com/*

Additional publications regarding the use of electronic and information technology use by people with disabilities can be found at *http://www.washington.edu/doit/Brochures/Technology/*. Select *Disability-Related Resources on the Internet* for a comprehensive list of discussion lists and Web sites.

To locate technical assistance centers in your state or region, consult *http://www.resna.org/taproject/at/statecontacts.html* or *http://www.adata.org/dbtac.html*, respectively.

Grants and gifts fund DO-IT publications, videotapes, and programs to support the academic and career success of people with disabilities. Contribute today by sending a check to DO-IT, Box 355670, University of Washington, Seattle, WA 98195-5670.

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About DO-IT

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